The Advanced Test Reactor (ATR)

Idaho National Laboratory's Advanced Test Reactor has many uses, including national security and energy applications, and medical isotope production.

The ATR is a pressurized water test reactor that operates at low pressure and low temperature. It is located at the Advanced Test Reactor Complex on the Idaho National Laboratory (INL) site, about 40 miles from Idaho Falls, Idaho, and 120 miles from Jackson, Wyoming.

***Reactor Type*:** The reactor is pressurized and is cooled with water. The reactor core includes a beryllium reflector (the reflector helps concentrate neutrons in the reactor core, where they are needed for fuels and materials testing).

***Reactor Vessel*:** The vessel is a 12-foot diameter cylinder, 36-feet high, made of stainless steel.

***Reactor Core*:** The core is 4 feet in diameter and height and includes 40 fuel elements.

Coolant Temperatures and Pressure: The reactor inlet temperature is 125°F, and the outlet temperature is 160ºF. The reactor pressure is 390 pounds per square inch.

The ATR has many uses

National Security - The ATR has provided the critical testing capability that has helped develop our nation's nuclear Navy:

- The Navy is the major customer and user of the ATR.
- The ATR testing has contributed to the exceptional operational performance of our nuclear-powered fleet.

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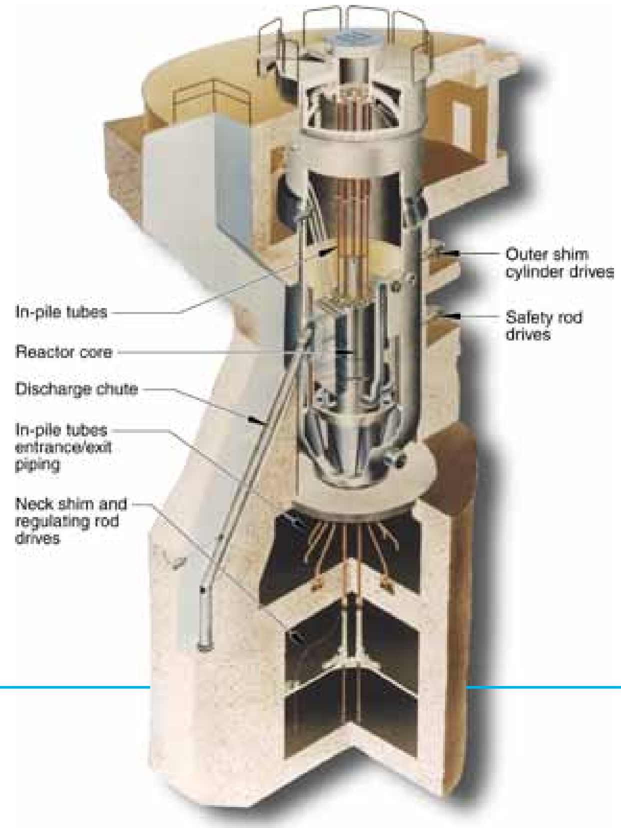
The Energy of Innovation

Idaho National Laboratory



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***Nuclear Energy* -** The ATR testing supports power reactors around the world:

- Current nuclear power plants – extension of operating life
- Development of future reactor designs
- Testing of new nuclear fuel types that can reduce waste generation and proliferation risk

***Isotopes* -** The ATR fills a critical need for isotope production:

- Medical Isotopes - The ATR is the only U.S. reactor capable of producing certain medical isotopes in the quantity and quality needed to support this ever expanding and promising field of medical treatment:
- The ATR produces the cobalt isotope needed for the “gamma knife” used to treat brain tumors.
- The ATR is the reactor of choice for the production of a cesium isotope needed for treatment of soft tissue cancer.
- The ATR has had long standing programs to produce both iridium and cobalt isotopes needed for radiography.
- The ATR has been selected to produce plutonium-238 for space and security power systems.

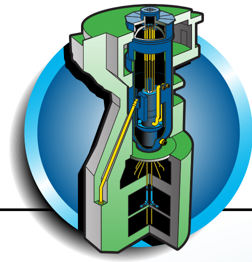
The ATR has a confinement structure

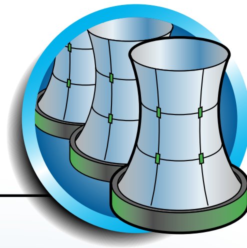
The ATR is housed in a large, heavy-walled, stainless steel container (called a vessel) that extends more than 20 feet underground surrounded by massive concrete walls and support structure. As such, the reactor is very well protected from intentional or accidental damage (such as a plane crash). An industrial enclosure, called a confinement structure, surrounds the reactor area and serves as an additional barrier in the highly unlikely event of a release of radioactivity. The ATR’s confinement structure is similar to that used to cover most test reactors, but the ATR vessel and vessel enclosure structure is significantly stronger than typical test reactors.

Commercial reactors, however, operate at much higher temperatures and pressures than the ATR and, in the unlikely event of severe

The high operating temperature and pressure of commercial reactors require them to have a robust containment structure.

core damage, a commercial reactor could release a great deal of radioactivity. Accordingly, commercial reactors are required to have a more robust enclosure called a containment structure (two large dome-shaped structures shown in photo). A general comparison between the ATR and a commercial pressurized water reactor provided at right illustrates why a more massive enclosure is required for commercial reactors.





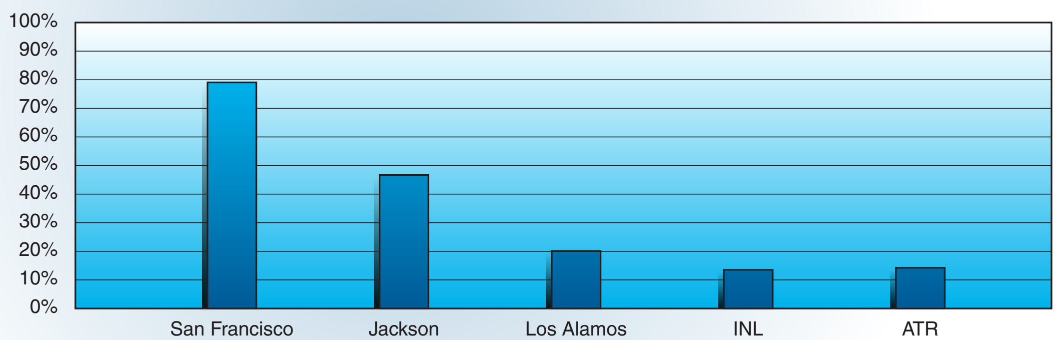
Advanced Test Reactor	Commercial Reactor
Confinement Structure	Containment Structure
Operating Conditions: – 390 psia – 140° F	Operating Conditions: – 2600 psia – 550° F
Reactor Core: – 4ft X 4ft (50 cubic feet) – 95 pounds of Uranium	Reactor Core: – 12ft X 12ft (1700 cubic feet) – 12,000 pounds of Uranium

This comparison illustrates why a more massive enclosure is required for commercial reactors.

The seismic hazard faced by the ATR is well understood and manageable

The ATR is located on the Snake River Plain, which is seismically quiet compared to the surrounding mountains. The map below shows seismic events from 1850-2003 with magnitudes greater than 5.0. As shown in the map, many significant seismic events (indicated in green dots) have been recorded in the mountains around the INL Site, but the Site, itself, is well isolated from these events.

Claims have been made regarding the seismic hazard "zone" in which INL resides. The zone nomenclature was part of the Uniform Building Code, which was replaced in 2000 with the International Building Code (IBC). The IBC is much more precise, and considers earthquake ground movements in percent of ground motion acceleration (%g). The U.S. Geological Survey ground motion data for various locations are presented above.



This graph compares U.S. Geological Survey groundmotion data for various locations.

The ATR is safe

While the ATR has been operating for more than 35 years, the ATR's unique design allows for operation well past its current age. For most reactors, the factor that limits

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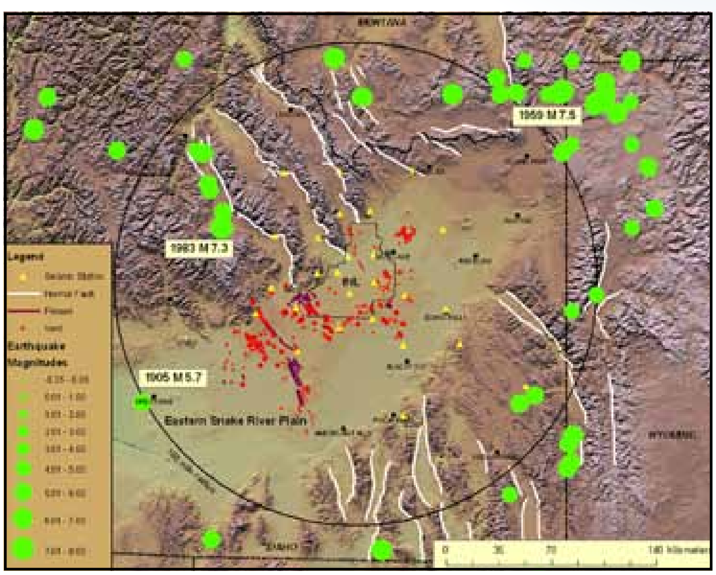

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reactor life is embrittlement of the reactor vessel and core components due to irradiation effects. With the ATR, the key components in the reactor core are replaced every 8 to 10 years. Because of the design of the reactor core, the reactor vessel is exposed to very little radiation, thus significantly slowing the effects of radiation embrittlement. The reactor is safe to operate today and through proper maintenance and periodic upgrades, the reactor will be able to operate safely, reliably and effectively for many years to come.

The ATR has a long history of safe operations. It has robust and mature operations and maintenance programs, a conservative design and operating philosophy, and well-trained and dedicated staff. Because of a solid safety ethic at INL, the ATR has never experienced a serious accident or incident. This strong safety culture at INL is reflected in the fact that radiation doses to the public from INL operations are so small that they are more than 100 times less than the regulatory limit.

With the upgrades that have been completed over the years, the ATR is safer today than it has ever been.

The ATR can be safely operated for the long-term

In 2003, a review of the ATR by DOE Headquarters Office of Independent Oversight and Performance Assurance (OA) examined the functionality and operability of selected safety systems for the ATR. To ensure that the systems could perform their intended functions, the review focused on adequacy of system design, configuration control, surveillance and testing, and maintenance and operations.

As a follow-up to the issues raised during this inspection, in February 2004 the DOE Idaho Operations Office commissioned an independent review of the ATR by a team of recognized national experts in reactor safety, regulation and licensing, and nuclear plant operations. The team concluded that the capability of the management and operating staff and the overall material condition of the ATR supported its continued near-term safe operations but that a comprehensive plan was essential to the long-term operation of the reactor.

In response, DOE established a life extension program, aimed at identifying the actions needed over the next 10 years to assure the currency of the safety documentation for the reactor and its continued operation. Safety analysis is an important tool for understanding the operating envelope for a reactor, to assure that the plant can be operated in accordance with the most current safety standards.

The life extension program plan addresses such issues as the procurement and availability of critical spare parts, including one-of-a-kind components (*e.g.,* safety rods, core internal components, beryllium reflector), staffing requirements, and identifies the funding, schedule, and prioritization for replacement of key components and systems. This plan is a key part of the strategic plan for the long-term operation of the reactor and the planning basis for DOE's budget requests. Implementation of the plan began in FY 2005 and funds have been provided in FY 2006 to continue this important effort.

In 2005, OA conducted a follow-up inspection of the INL, which examined, in part, the progress of the laboratory in addressing the opportunities for improvement that had been identified in the 2003 inspection. While the review recommended that DOE take steps to accelerate efforts associated with the life extension program, it concluded that:

- The ATR has a strong nuclear safety culture.
- Operations and maintenance at the ATR are performed with high regard to safety.
- The ATR has made important progress in the update of its safety documentation and analyses.
- DOE is providing active oversight over the life extension program.

Importantly, the OA follow-up review concluded that important progress has been made since the 2003 review and that the team "did not identify any specific conditions for the systems reviewed that would warrant shutdown of reactor operations."

For more information

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